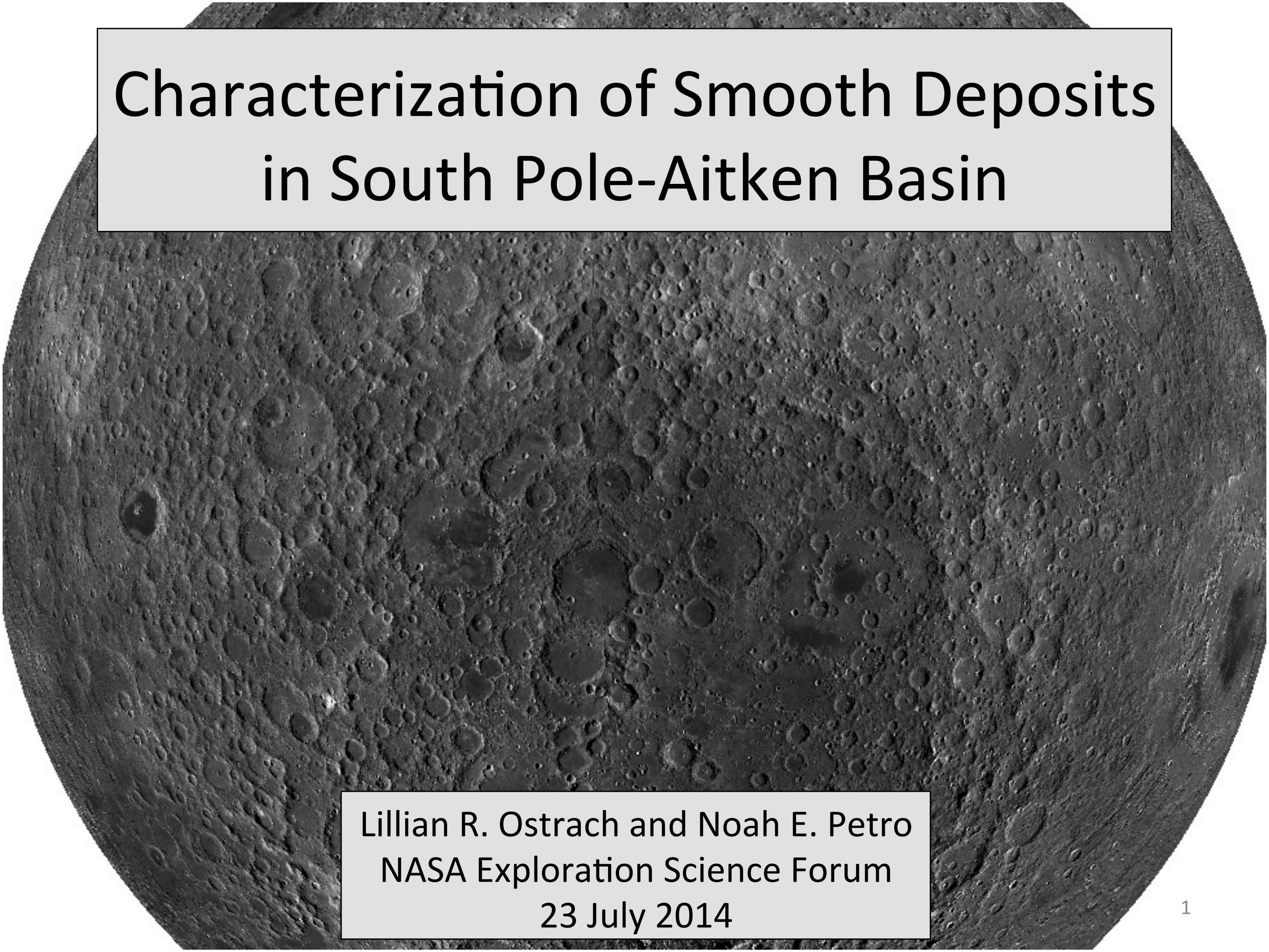
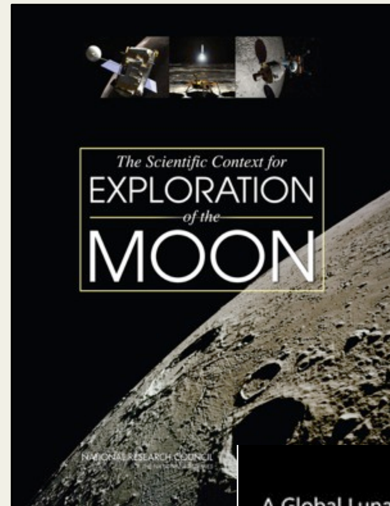
Characterization of Smooth Deposits in South Pole-Aitken Basin



Lillian R. Ostrach and Noah E. Petro
NASA Exploration Science Forum
23 July 2014

Motivation

SPA: High-priority target for exploration and sample return because multiple science objectives can be addressed

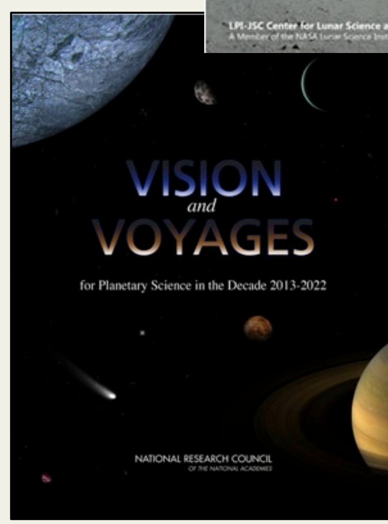


SCEM SC1: The Moon reveals the inner Solar System bombardment history

Goal 1a: Test the cataclysm hypothesis (basin ages)

Goal 1b: Anchor Earth-Moon impact flux (SPA age)

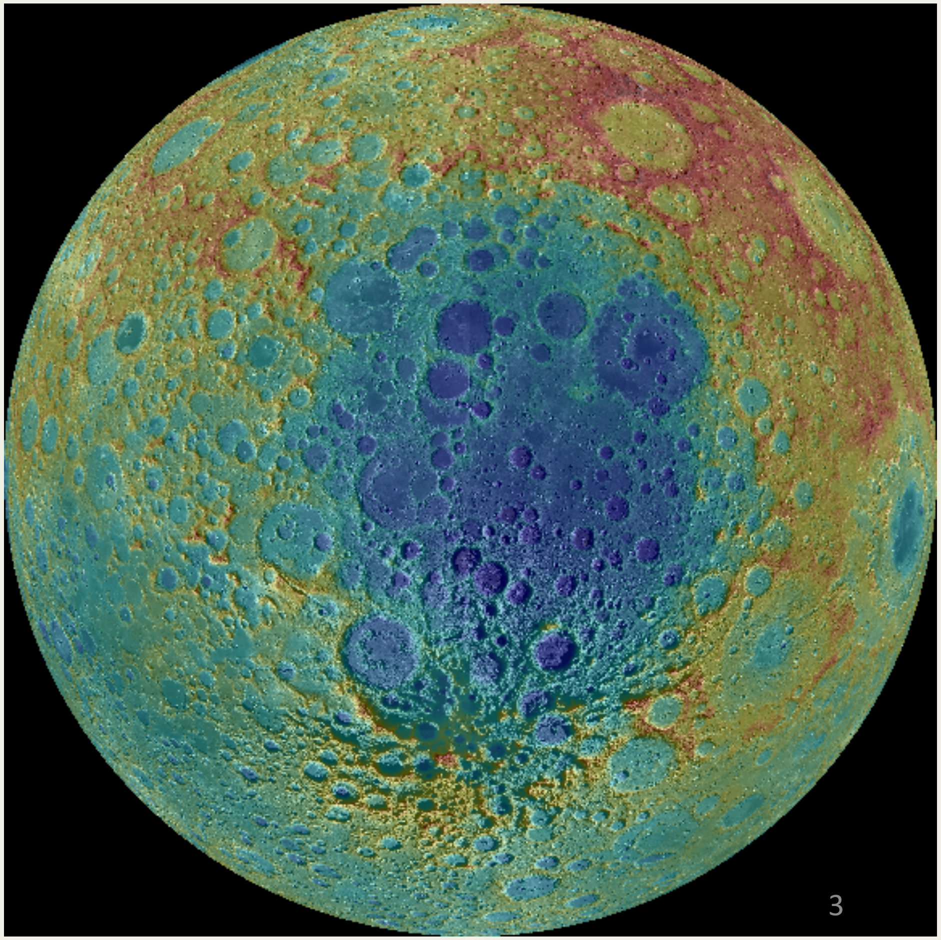
Goal 1c: "Establish a precise absolute chronology"



Also: lunar interior, impact process, volcanic evolution, regolith … which help to "[Reveal] planetary processes through time"

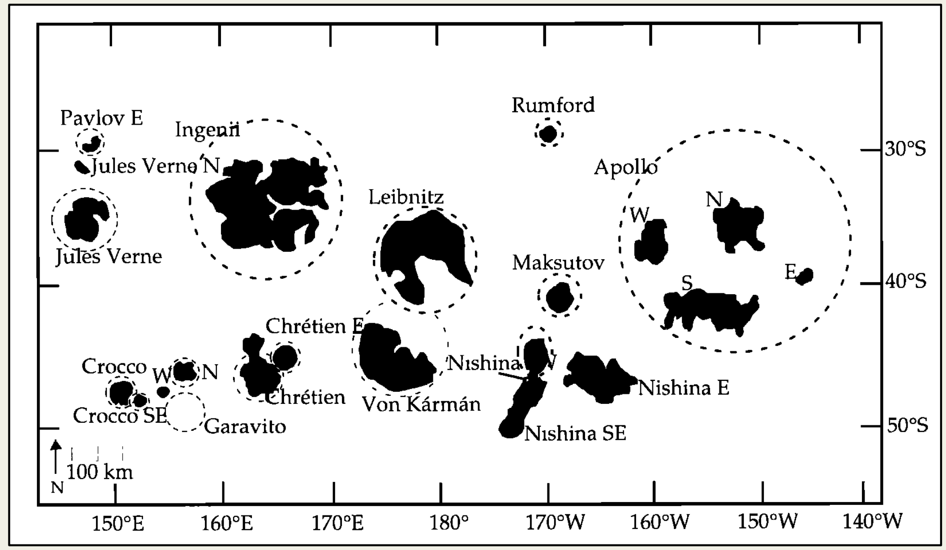
South Pole-Aitken Basin

<u>A few things we know:</u> oldest lunar basin, likely excavated mantle materials, but heavily modified (impacts, volcanism)



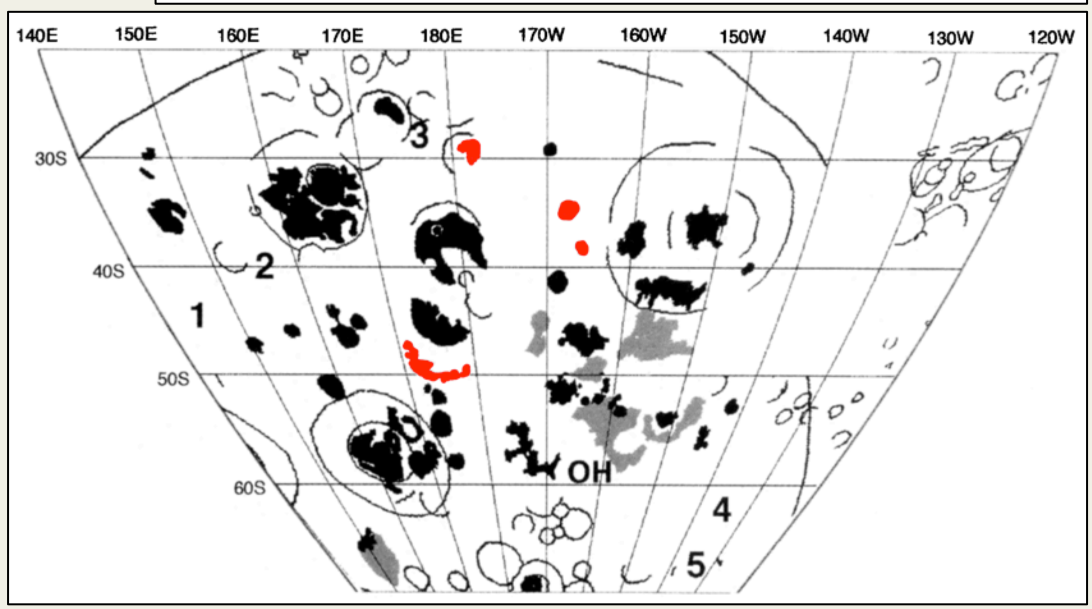
South Pole-Aitken Basin

mare deposits; Yingst and Head, 1999



<u>A few things we know:</u> oldest lunar basin, likely excavated mantle materials, but heavily modified (impacts, volcanism)

Geologic complexity → efforts to map = difficult



Black = confirmed basaltic; dark gray = intrinsically basaltic; red = likely pyroclastic

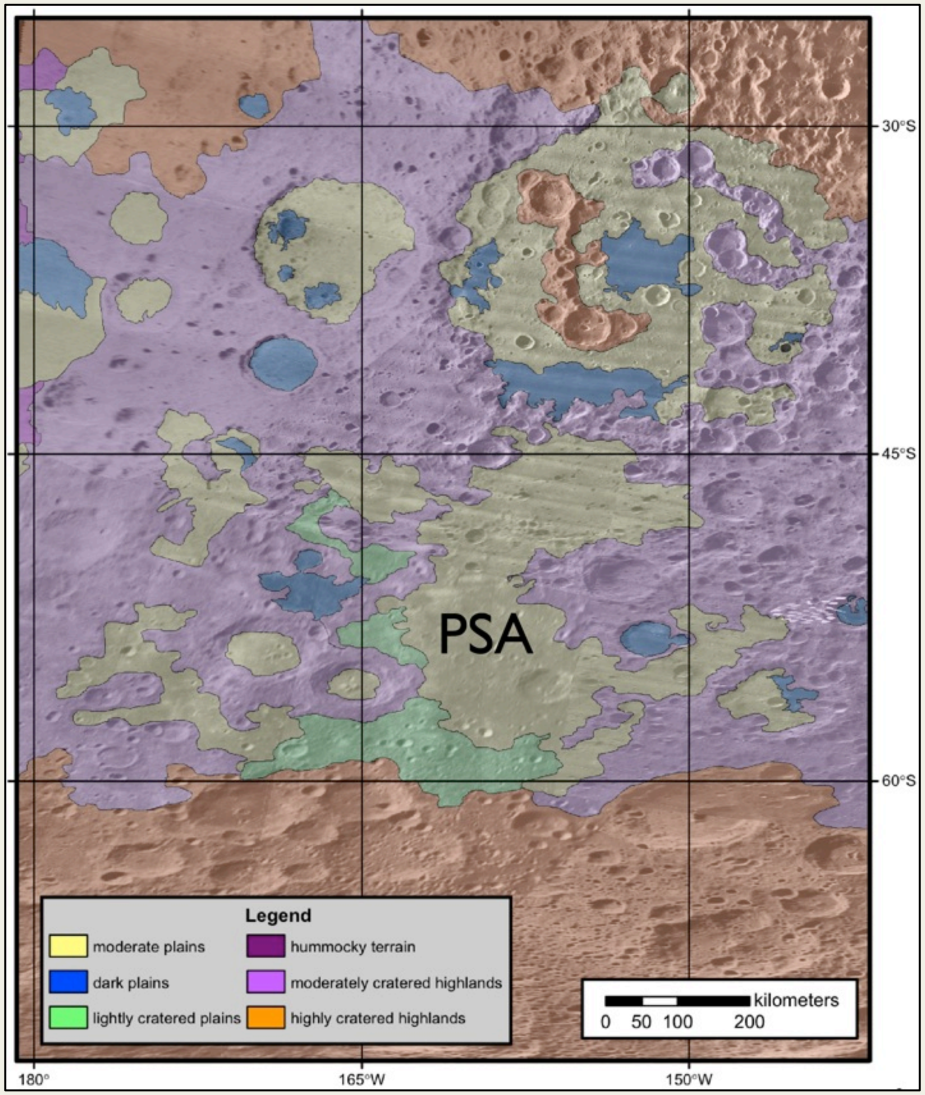
Pieters et al., 2001

South Pole-Aitken Basin

<u>A few things we know:</u> oldest lunar basin, likely excavated mantle materials, but heavily modified (impacts, volcanism)

Geologic complexity → efforts to map = difficult

Recent spacecraft data enable further characterization through a combination of approaches*

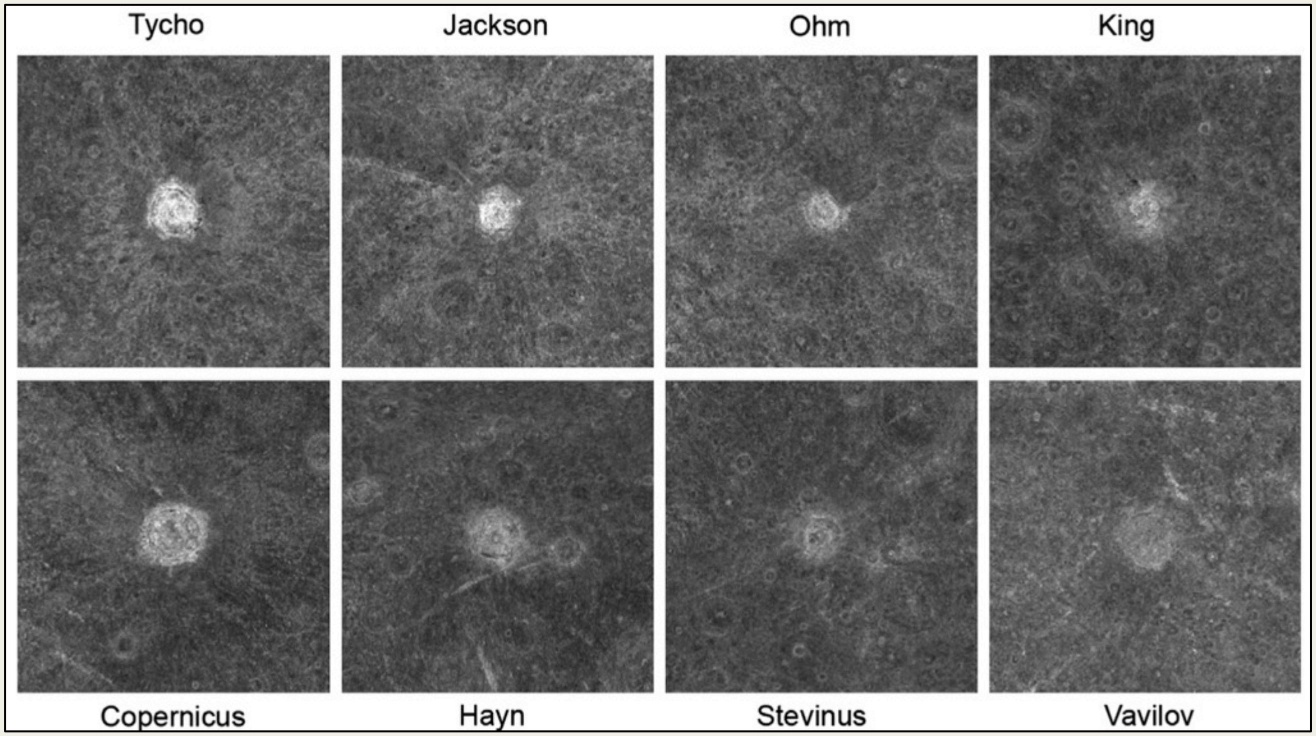


PSA = plains south of Apollo; Petro et al., 2011

LOLA Topographic Roughness

Kreslavsky et al. (2013): roughness calculated for a set of baselines, determined from separation between consecutive LOLA shots (~57.4 m) with even number of shot-to-shot steps

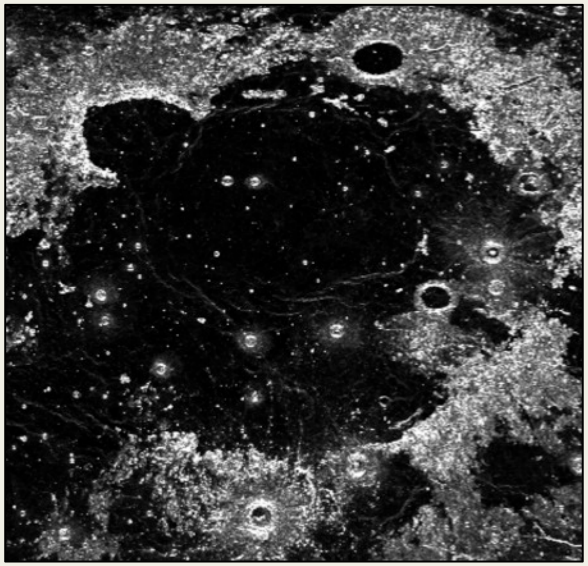
115 m baseline; brighter = rougher



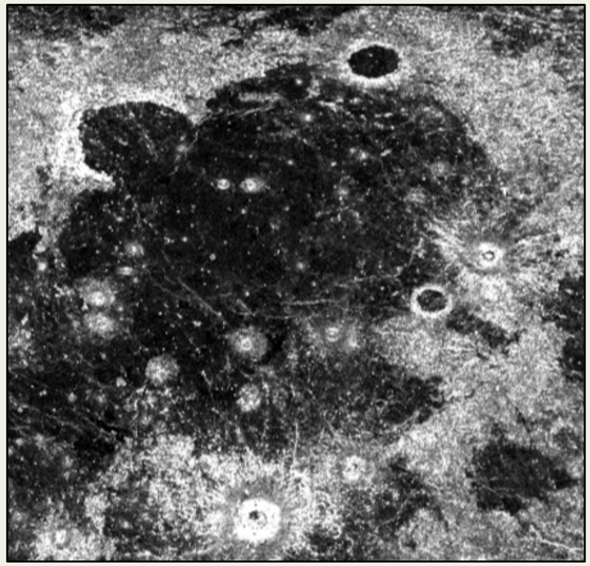
Rosenburg et al. (2011): surface roughness determined using a range of parameters (median absolute slope, median differential slope, Hurst exponent).

Mare Imbrium

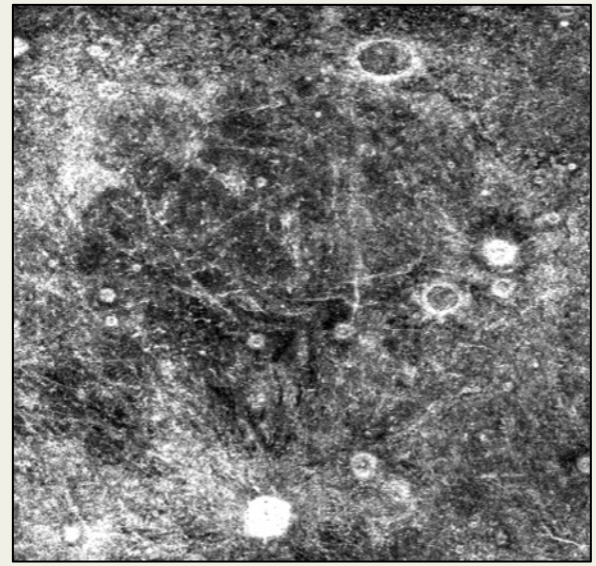
Relative roughness; brighter = rougher, darker = smoother



1.8 km baseline



0.46 km baseline

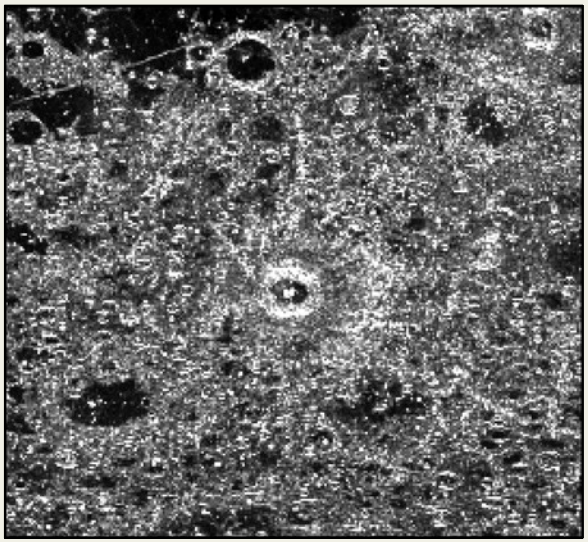


115 m baseline

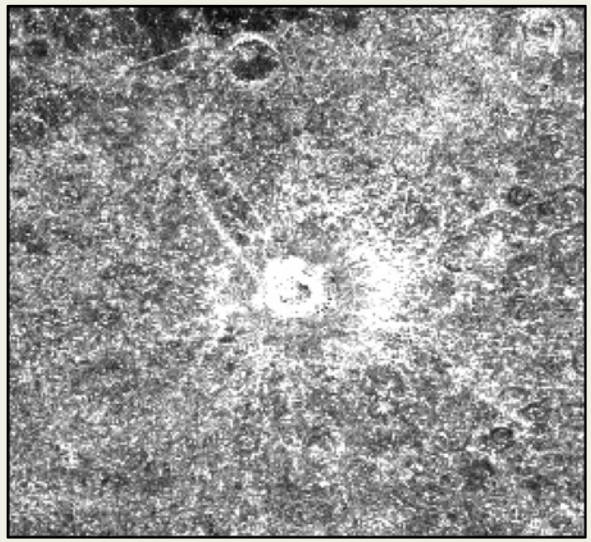
Copernicus crater diameter ~96 km

Tycho

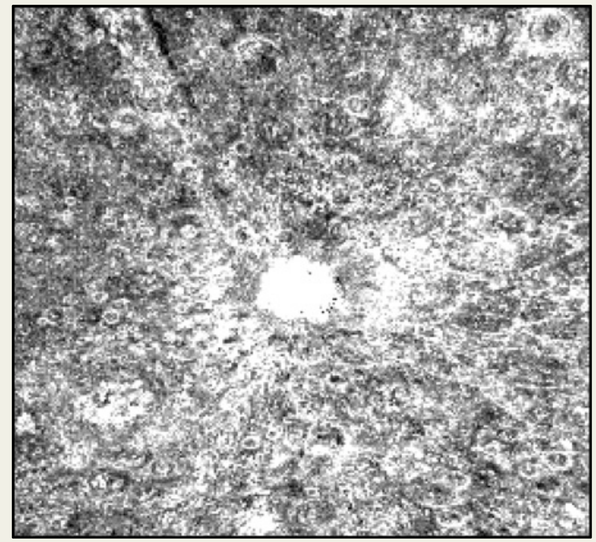
Relative roughness; brighter = rougher, darker = smoother



1.8 km baseline



0.46 km baseline

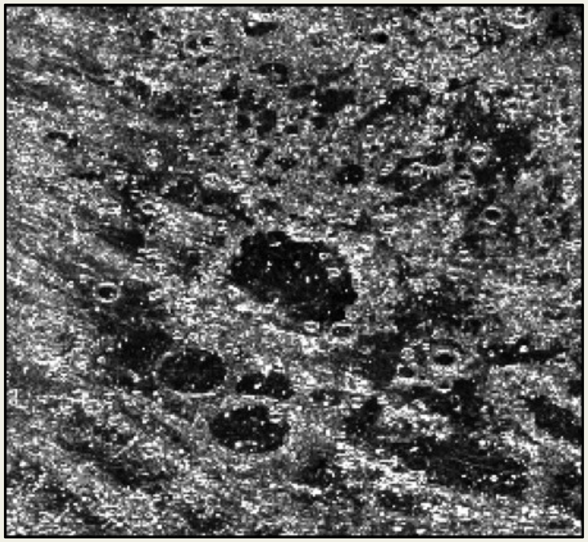


115 m baseline

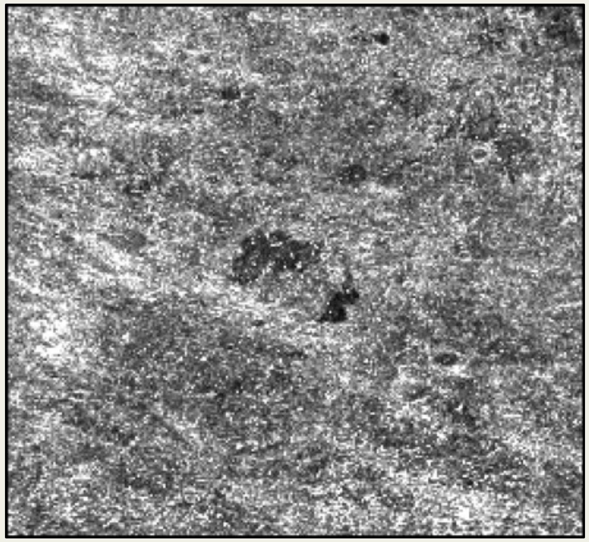
Tycho crater diameter ~85 km

Schickard – Ancient Mare

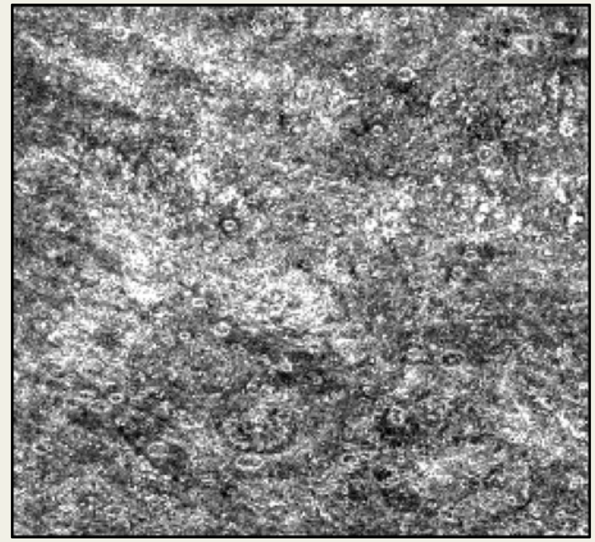
Relative roughness; brighter = rougher, darker = smoother



1.8 km baseline

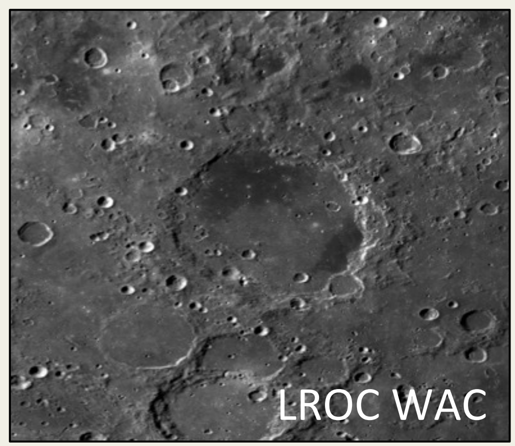


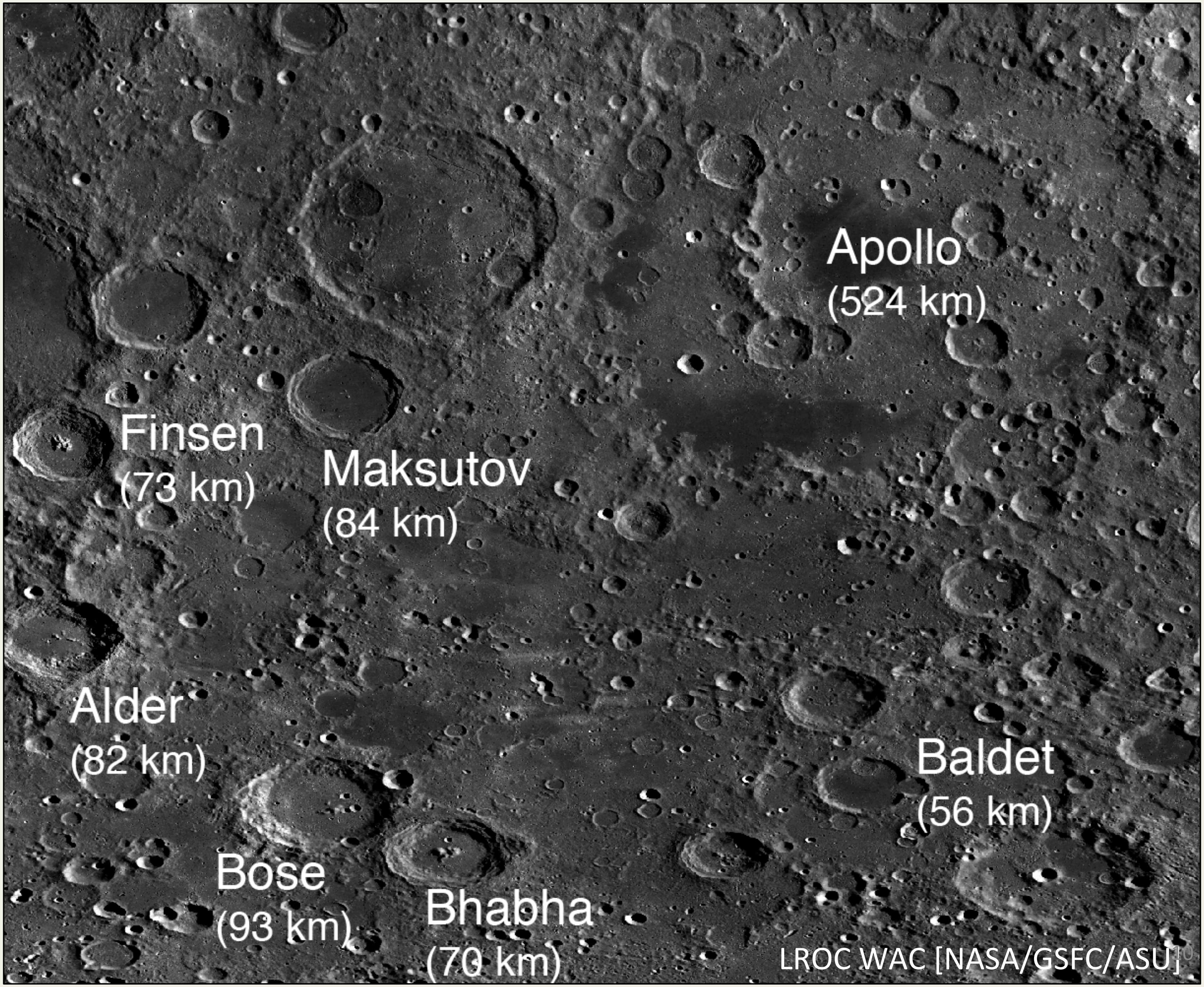
0.46 km baseline



115 m baseline

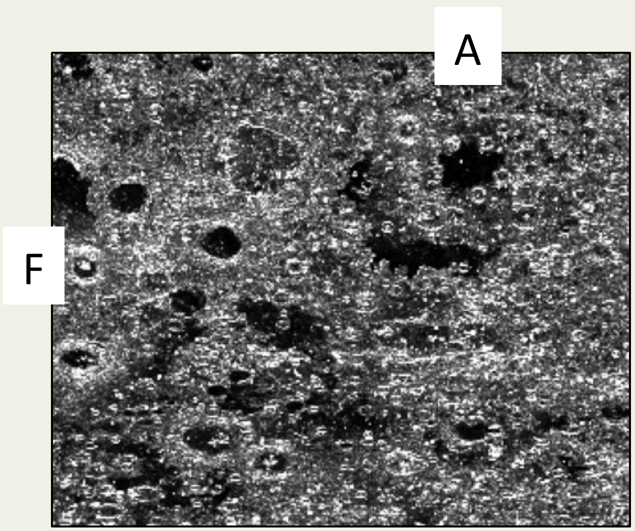
Schickard crater diameter ~212 km



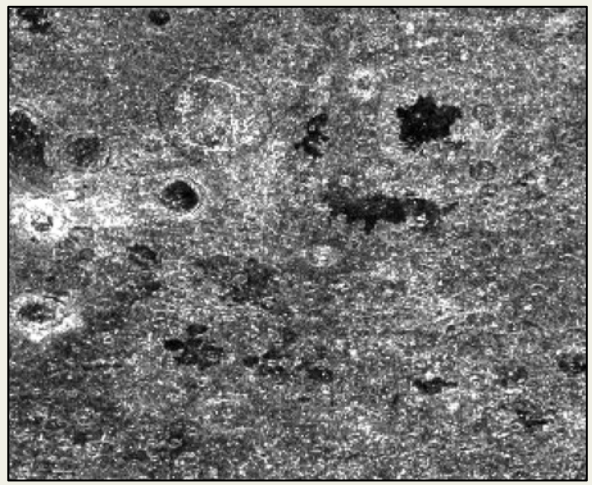

Apollo
(524 km)
Finsen
(73 km)
Maksutov
(84 km)
Alder
(82 km)
Baldet
(56 km)
Bose
(93 km)
Bhabha
(70 km)
LROC WAC [NASA/GSFC/ASU]

SPA Near Apollo Basin

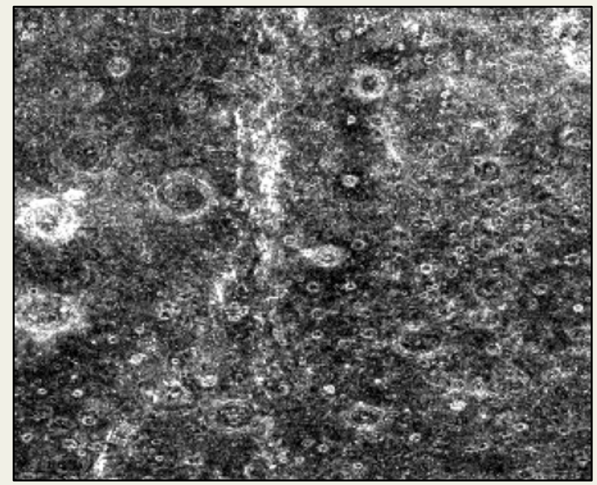
Relative roughness; brighter = rougher, darker = smoother



1.8 km baseline

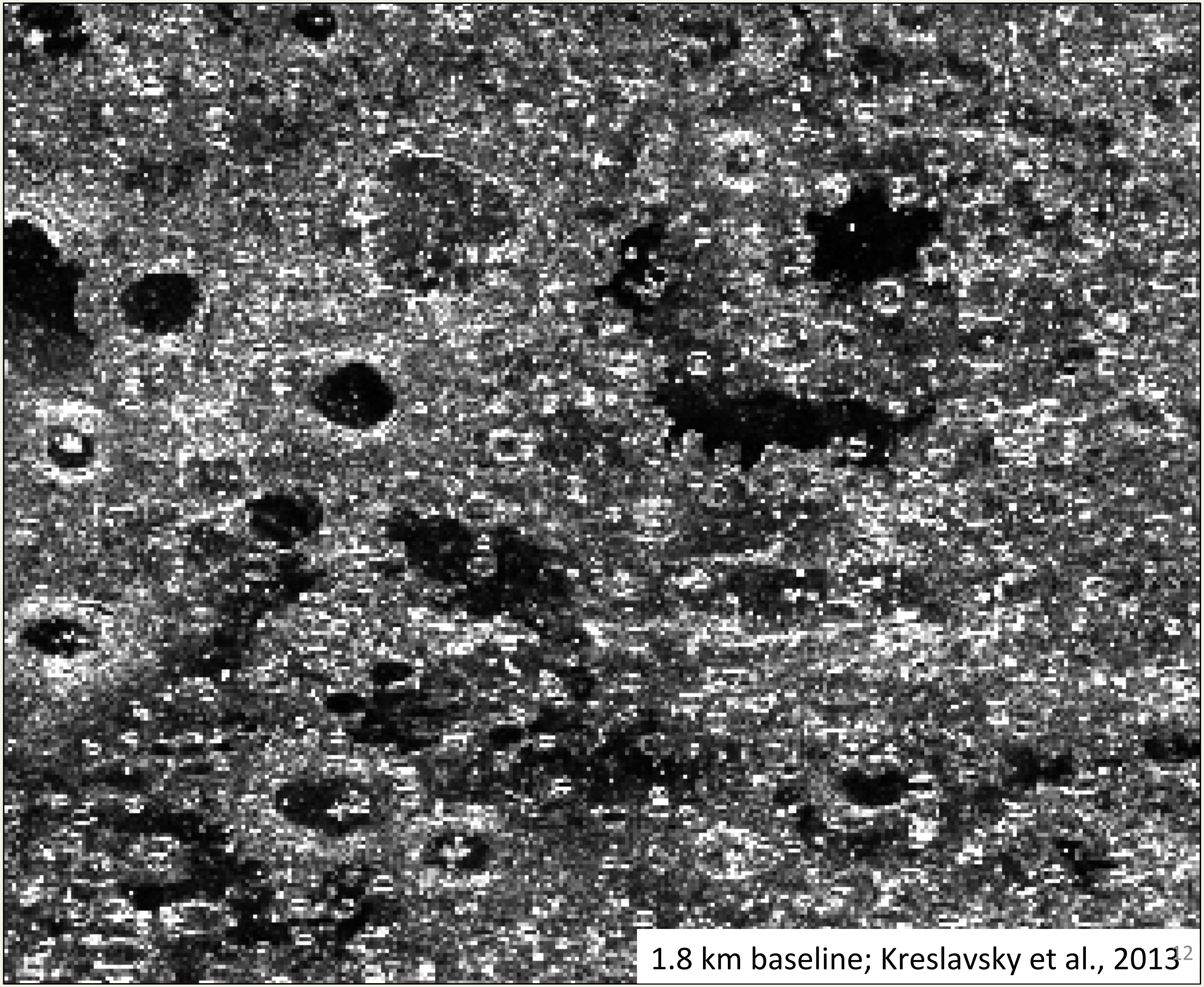


0.46 km baseline

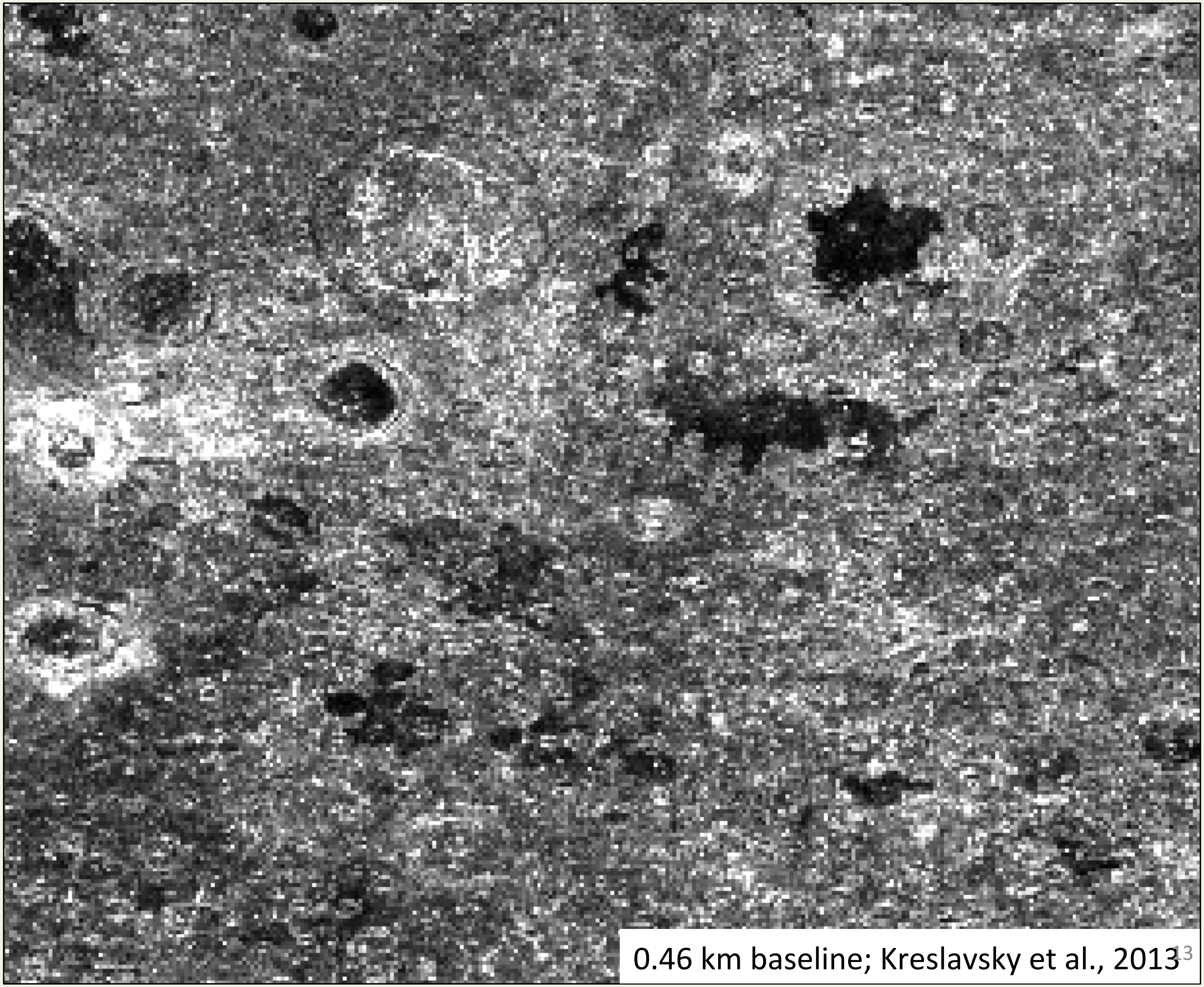


115 m baseline

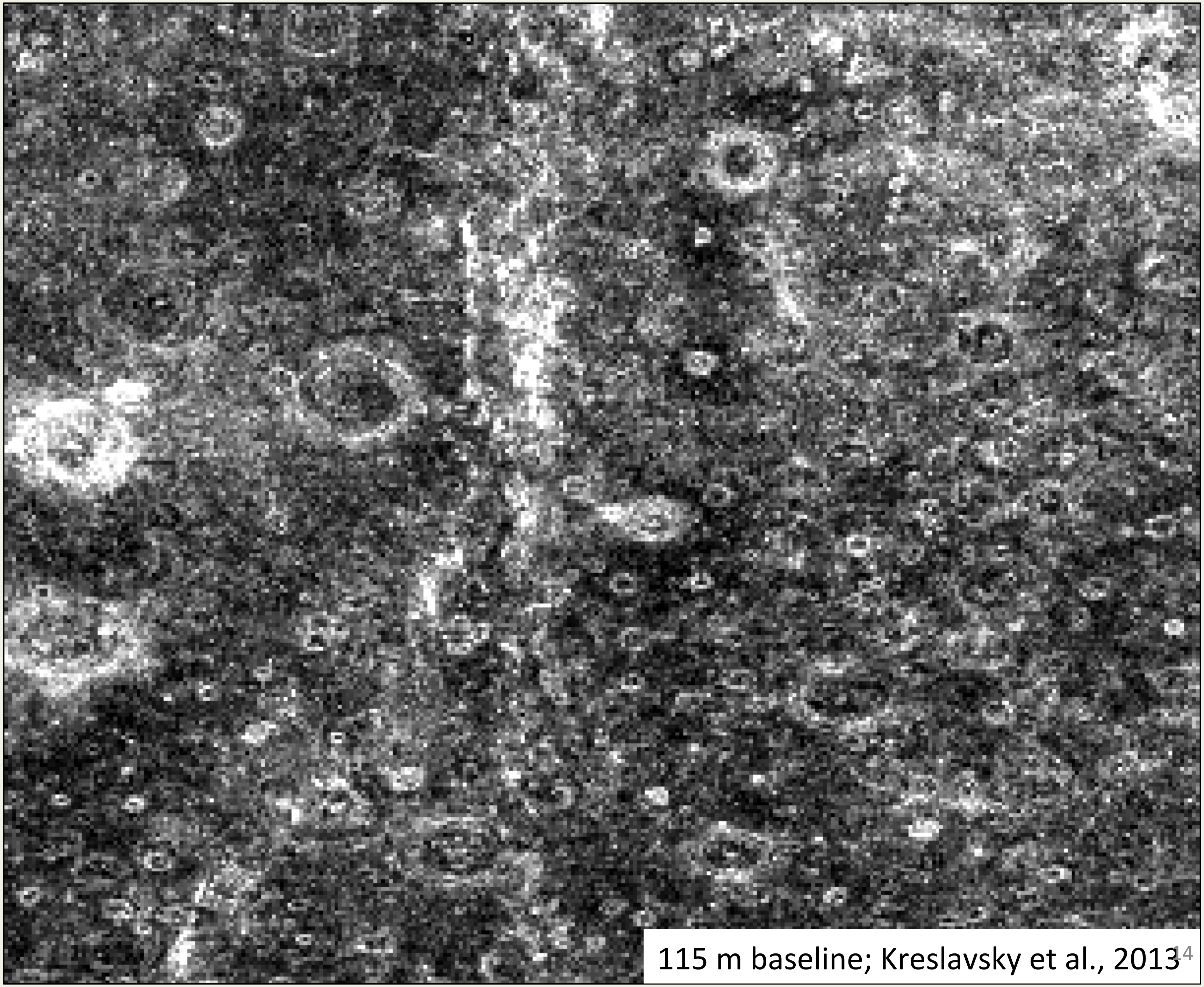
Finsen crater diameter ~73 km



1.8 km baseline; Kreslavsky et al., 2013

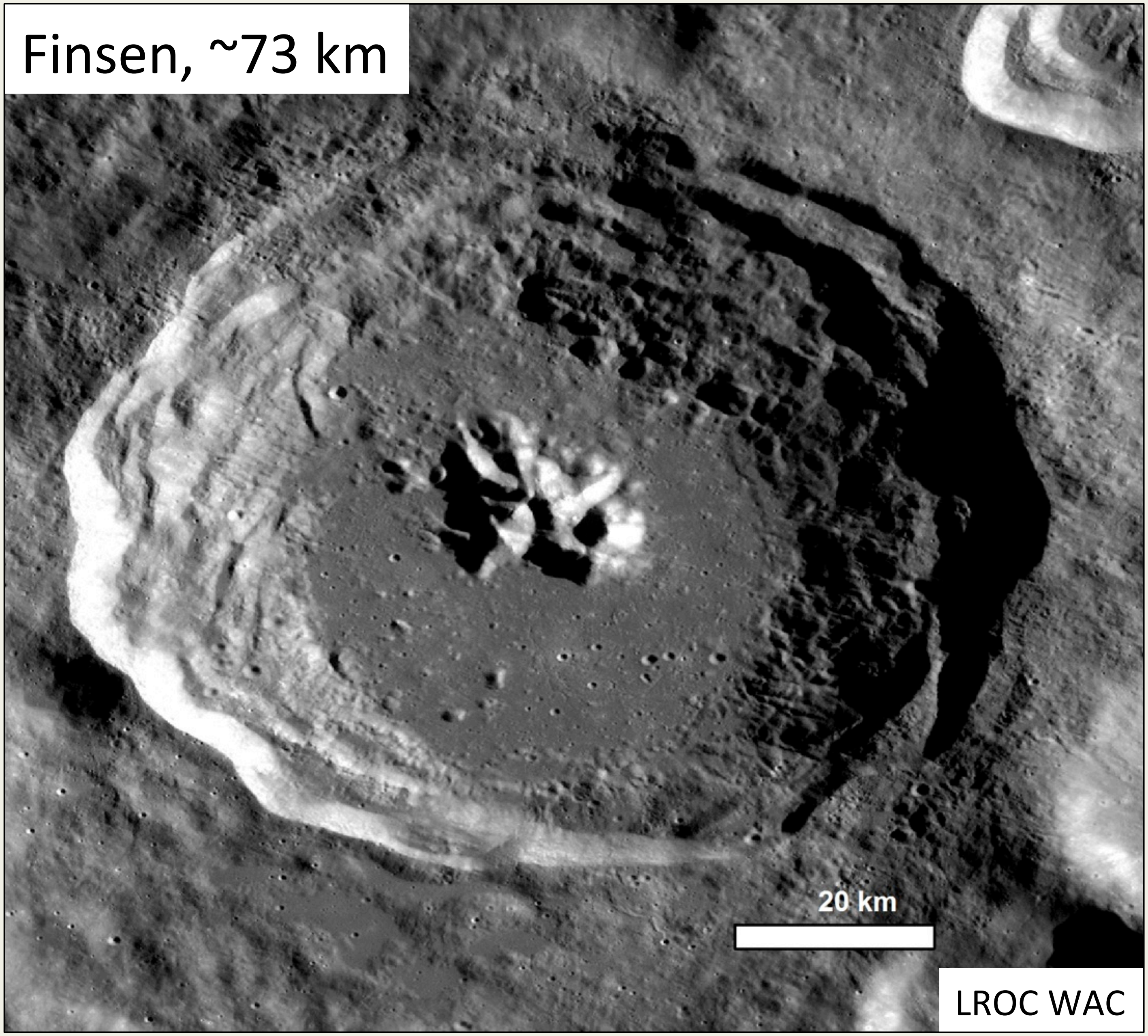


0.46 km baseline; Kreslavsky et al., 2013



115 m baseline; Kreslavsky et al., 2013

But what about impact melt?



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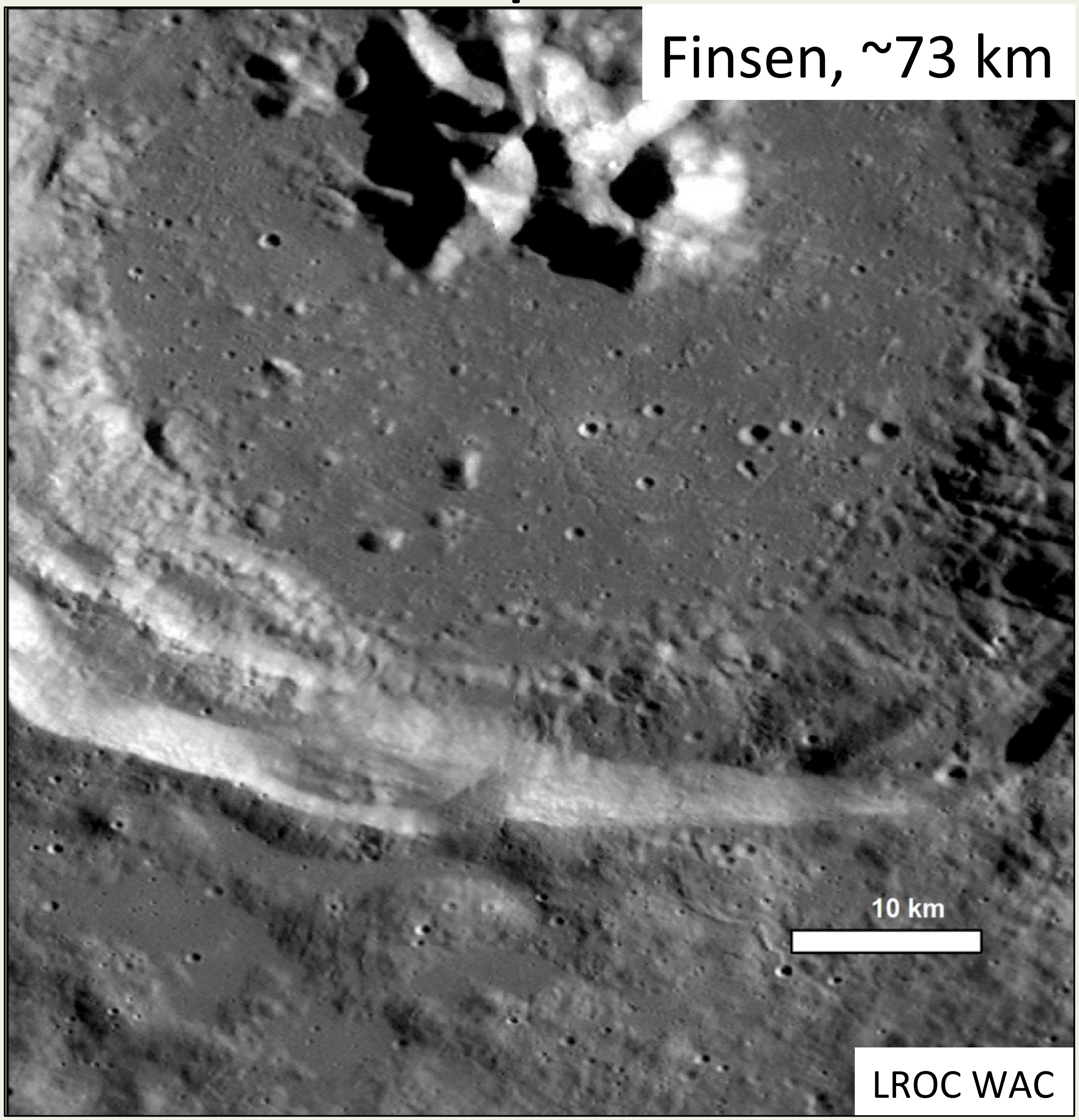

Conclusions and Future Work

Recent datasets enable new looks at persisting (old) questions and promote investigations benefiting from (requiring) the use of multiple datasets

LOLA-derived surface roughness at different baselines emphasize diversity of plains in SPA and relative crater ages

Currently more new questions than answers

Do melt and maria exhibit the same roughness elsewhere on the Moon? What “should” old plains look like compared to younger plains (in SPA and elsewhere)? How do old impact melts differ from old maria? Cryptomaria?

→LRОC, LOLA, Mini-RF, M^3, GRAIL, Kaguya/SELENE